(12) UK Patent Application (19) GB (11) 2 373 139 (13) A

(43) Date of A Publication 11.09.2002

(21) Application No 0122598.6

(22) Date of Filing 19.09.2001

(30) Priority Data
(31) 0105646 (32) 07.03.2001 (33) GB

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(51) INT CL[7]
H04Q 7/38 // H04M 1/725 , H04Q 7/00 7/20 7/24 7/32

(52) UK CL (Edition T)
H4L LECCP LECCX

(56) Documents Cited
WO 2001/003409 A1 WO 1998/041050 A1
WO 1998/012891 A1 WO 1997/001253 A1
US 5913160 A

(58) Field of Search
UK CL (Edition S) G4A AUDB , H4L LDPPX LECCP LECCX LEUX
INT CL[7] G06F 11/14 11/30 12/00 , H04L 12/22 12/26 , H04M 3/00 11/00 17/00 , H04Q 3/00 3/42 3/545 7/00 7/20 7/24 7/32 7/34 7/36 7/38 11/00
Online: WPI EPODOC JAPIO

(54) Abstract Title

A backup system of data stored on a sim card of a mobile telephone

(57) If a SIM card is lost, due to, for example, loss or theft of the mobile telephone, the data recorded on the SIM card will also be lost. In addition, accidental deletion or corruption of the data recorded on the SIM card is possible. In order to overcome such massive inconvenience to the user, the current invention provides a data backup system. The application discloses a data backup system for a database 8 comprising means for updating the data base, means for wirelessly transmitting the updated data to a remote data storage system 3 and means for storing the updated data at the remote data storage system.

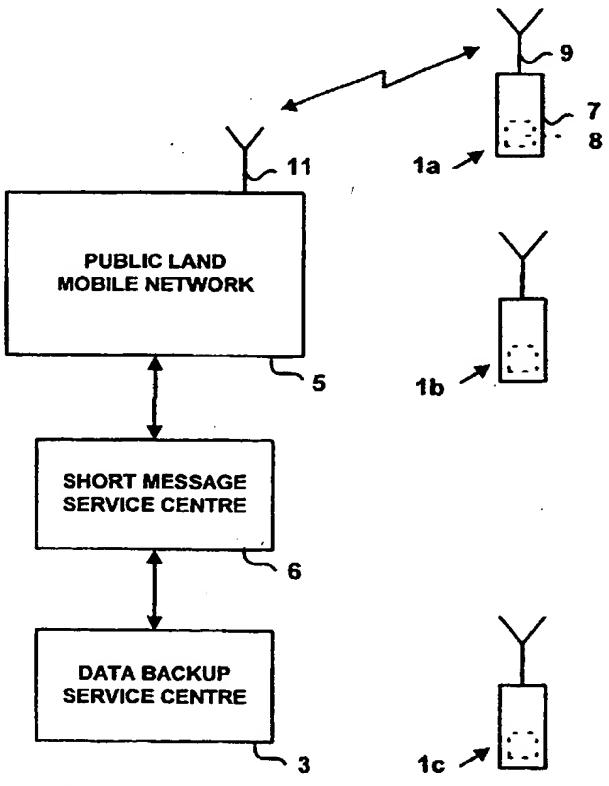

FIG. 1

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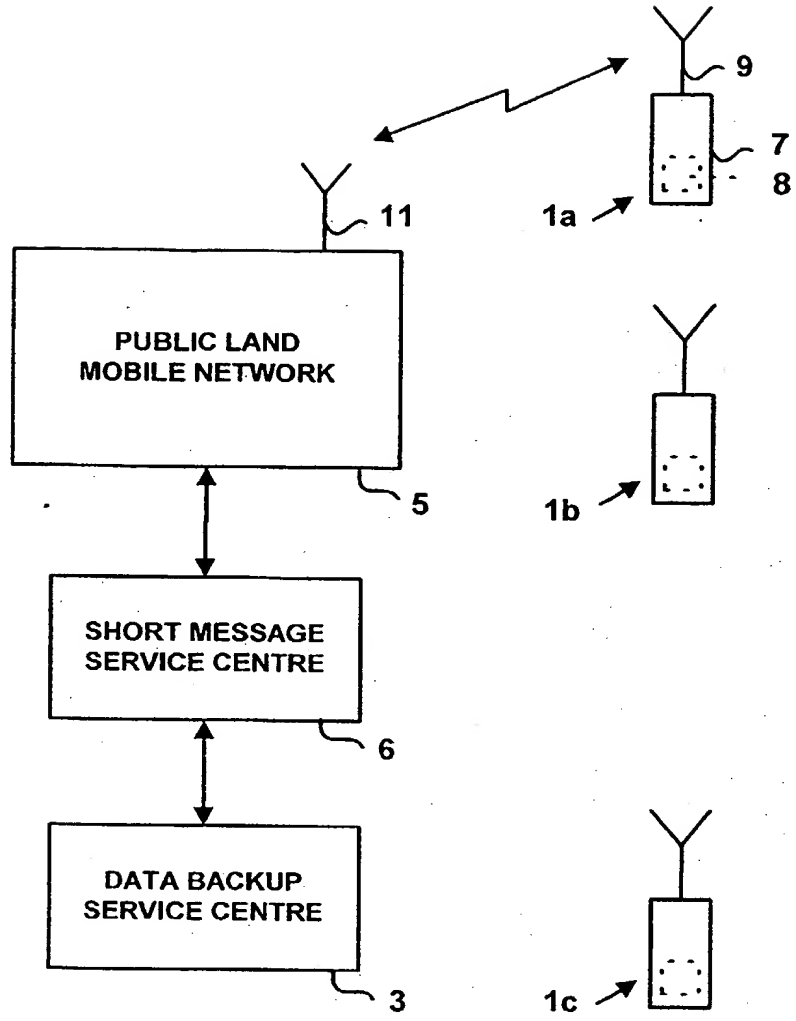

FIG. 1

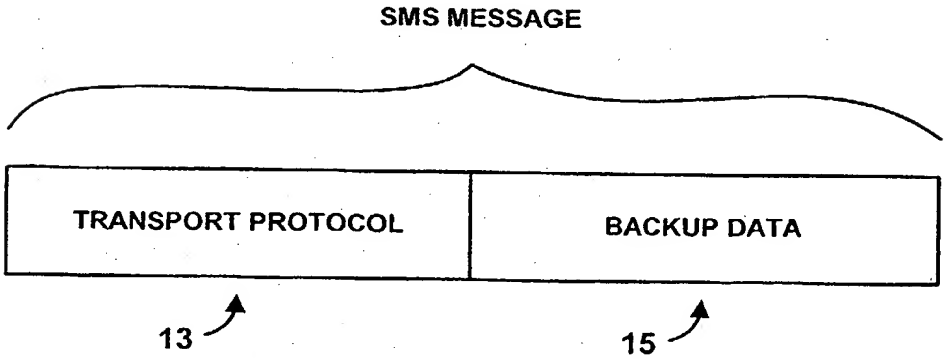

FIG. 2

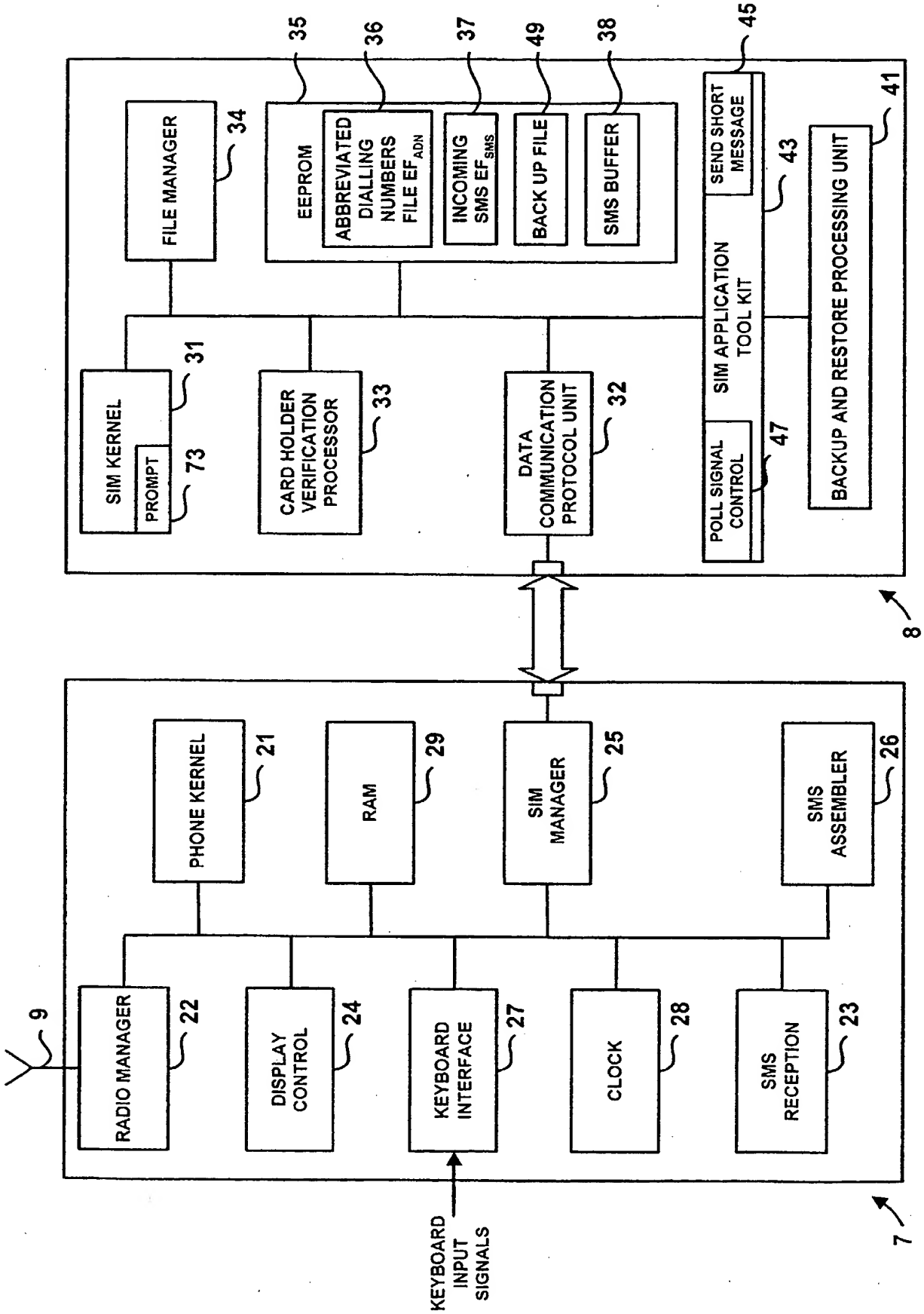

FIG. 3

ENTRY NUMBER (i)	ALPHA IDENTIFIER	DATA LENGTH	TYPE OF NUMBER AND IDENTIFICATION	DIALLING NUMBER	CAPABILITY IDENTIFIER	NUMBER OF EXTENSION RECORD
1	BOB	30	91	001123456	-	1
2	HOME	26	81	020 81999	-	-
3	OFFICE	26	81	020 72003	-	-

FIG. 4

RECORD NUMBER	RECORD	CHECKSUM	CHANGE FLAGS
1	BOB	XXXX	1
2	HOME	XXXX	0
3	OFFICE	XXXX	0

FIG. 6

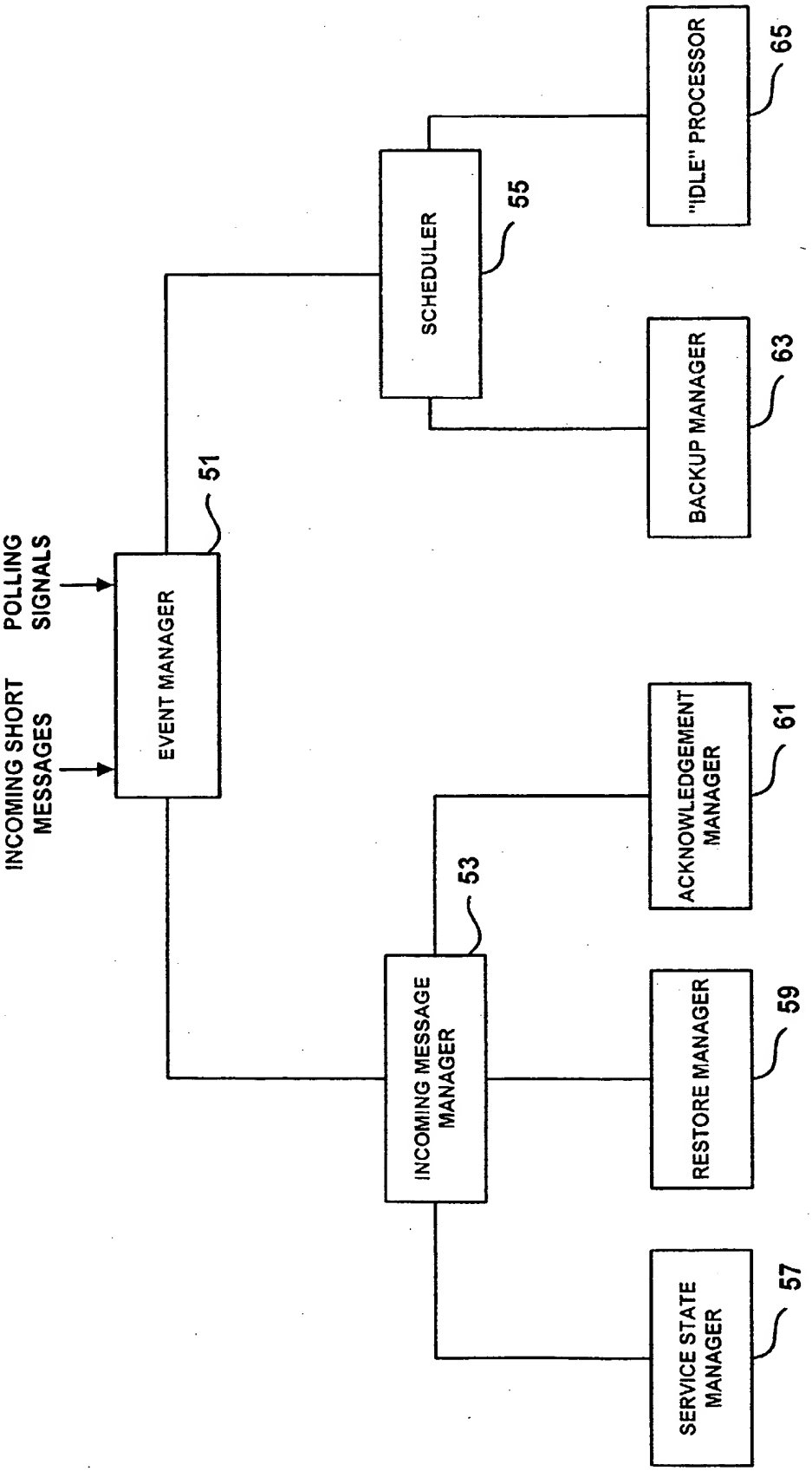

FIG. 5

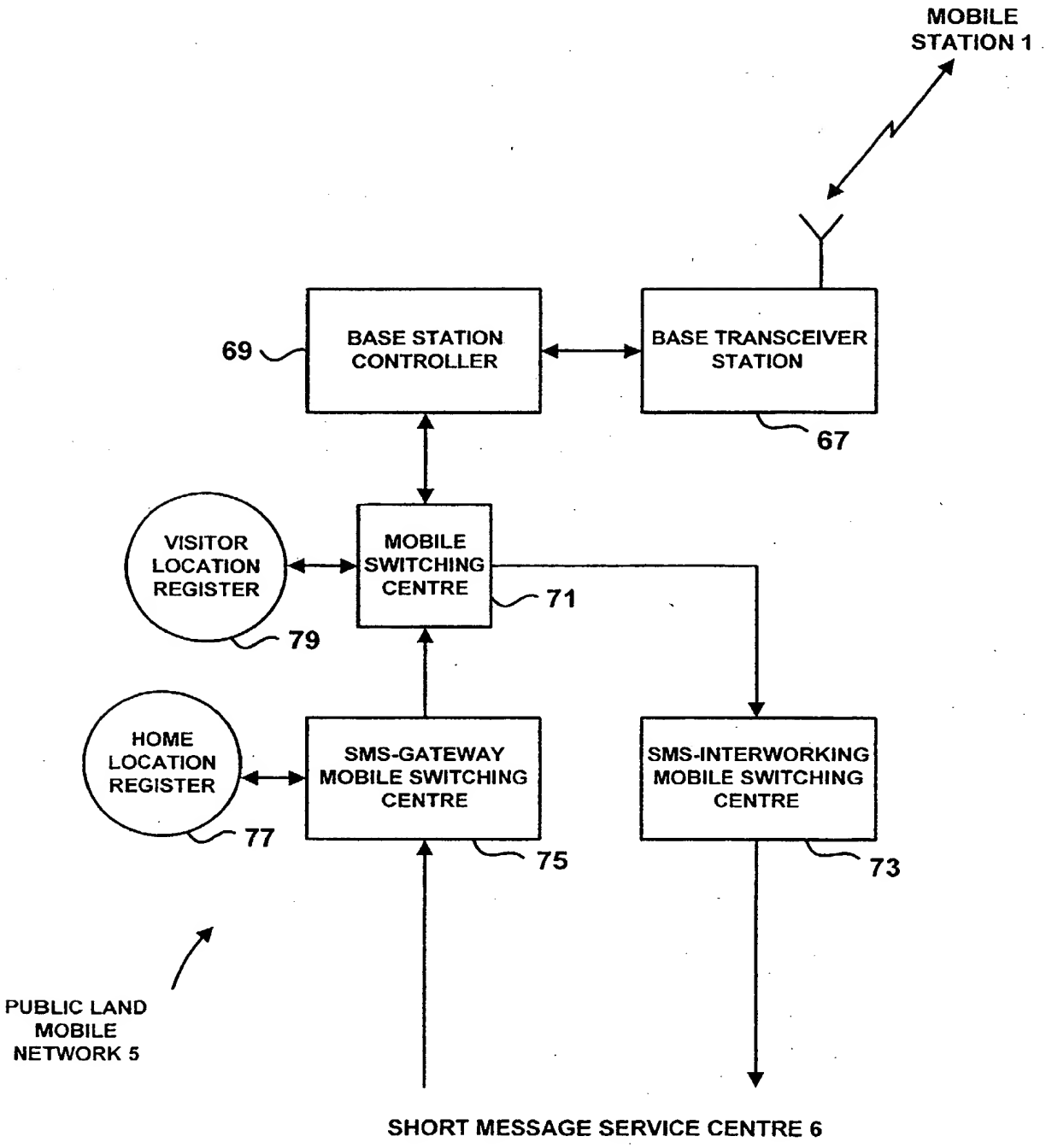

FIG. 7

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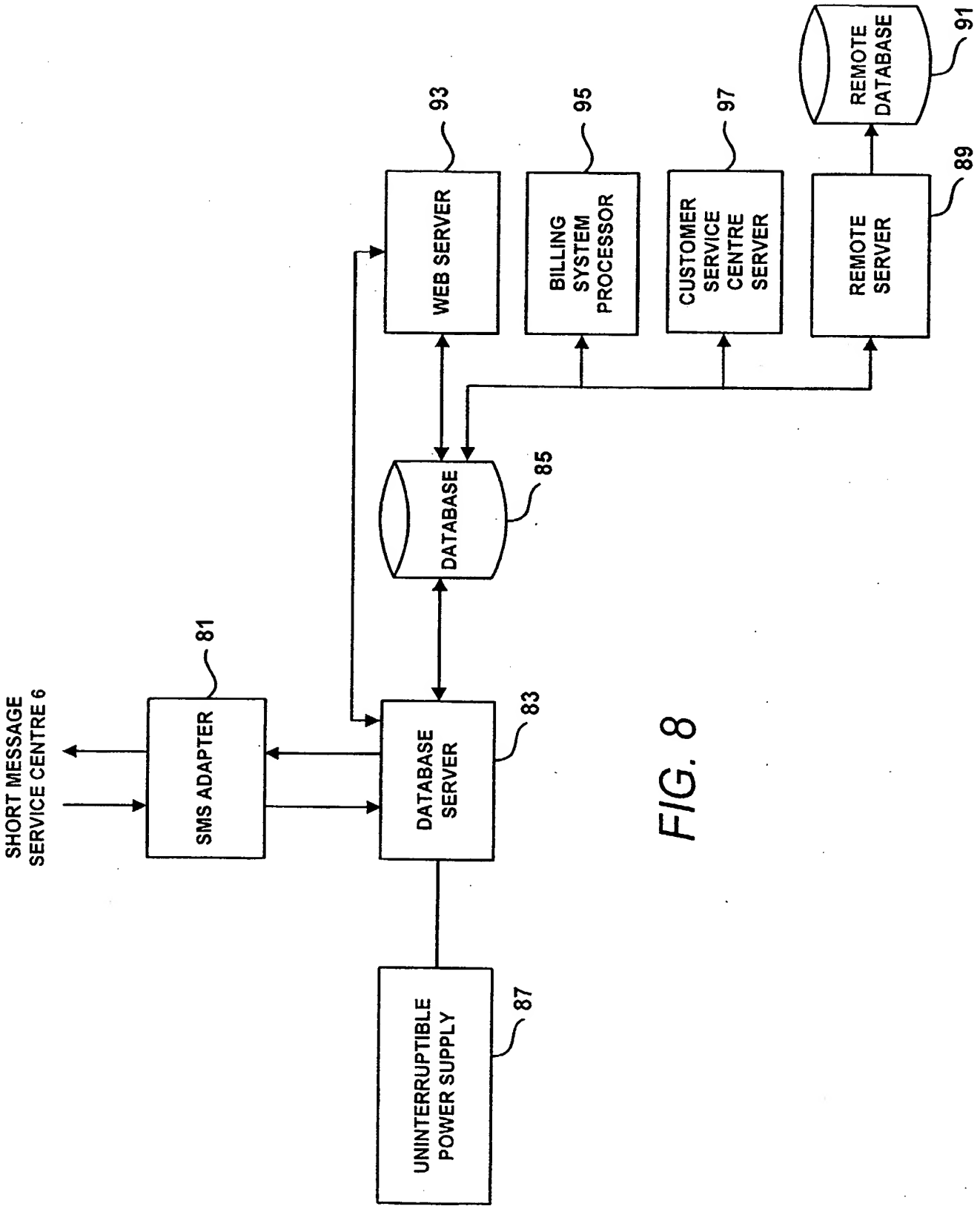

FIG. 8

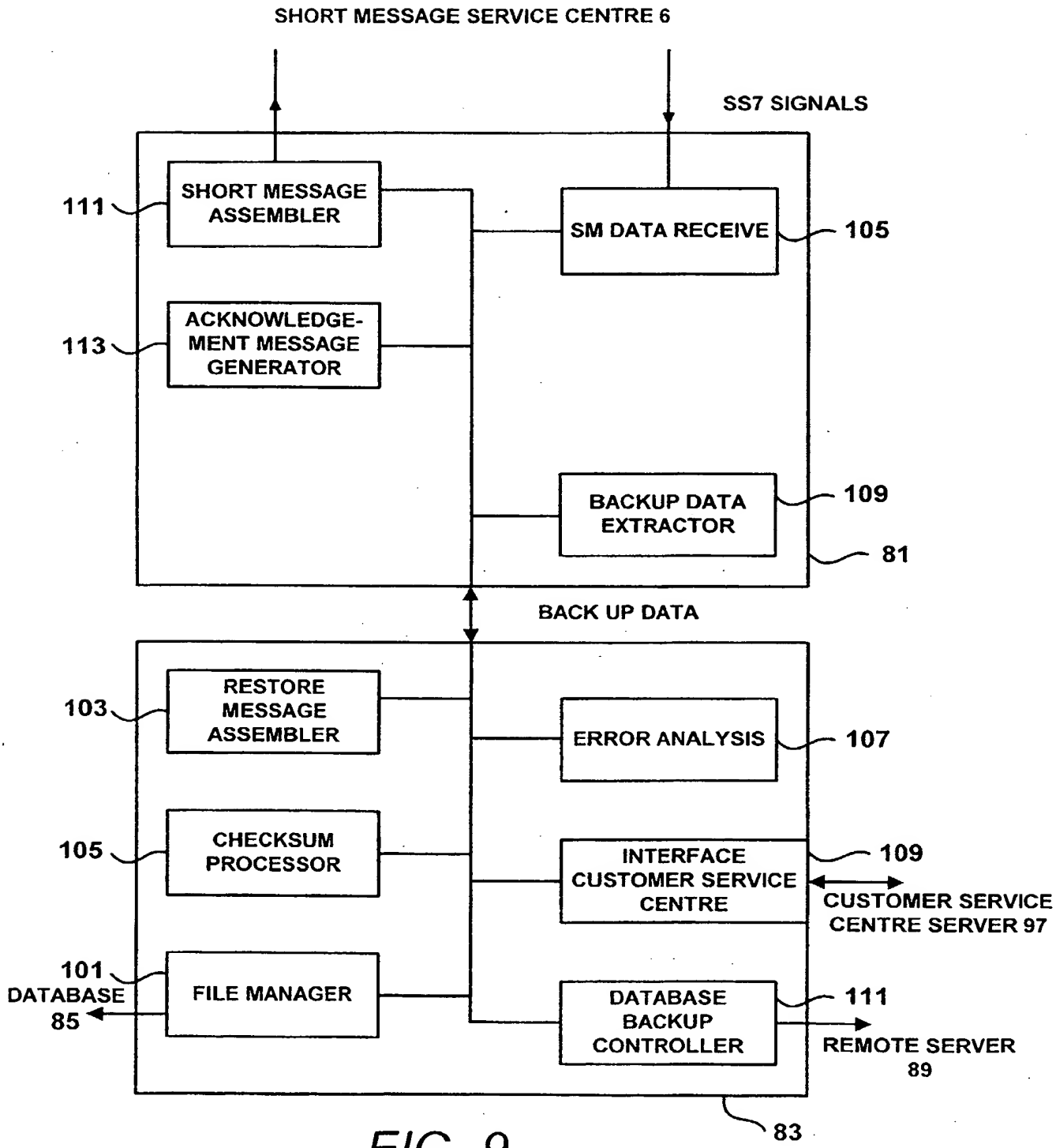

FIG. 9

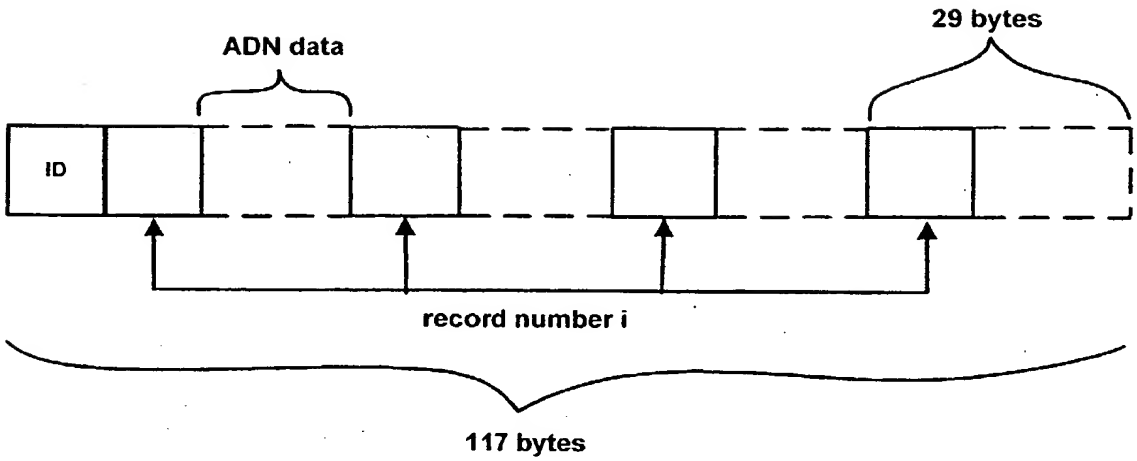

FIG. 10

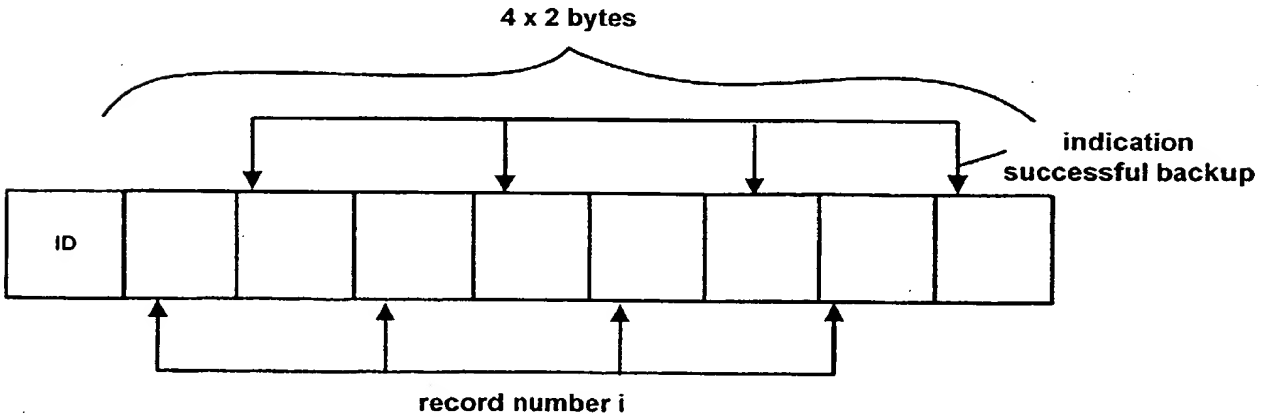

FIG. 11

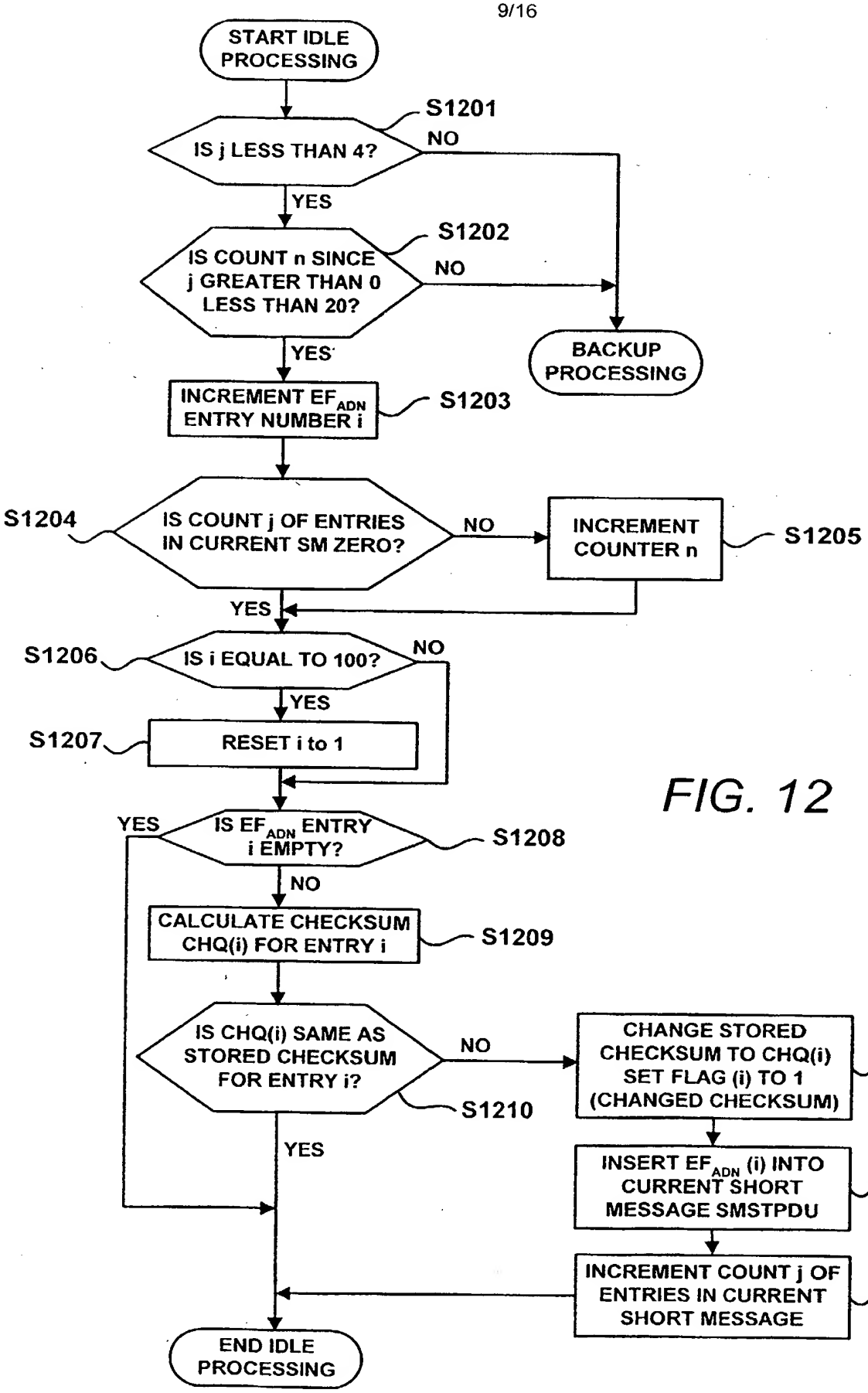

FIG. 12

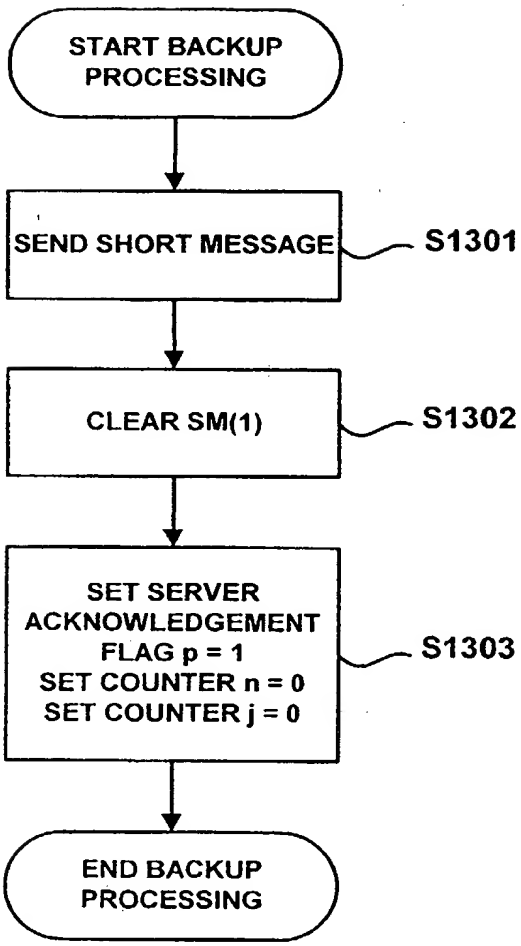

FIG. 13

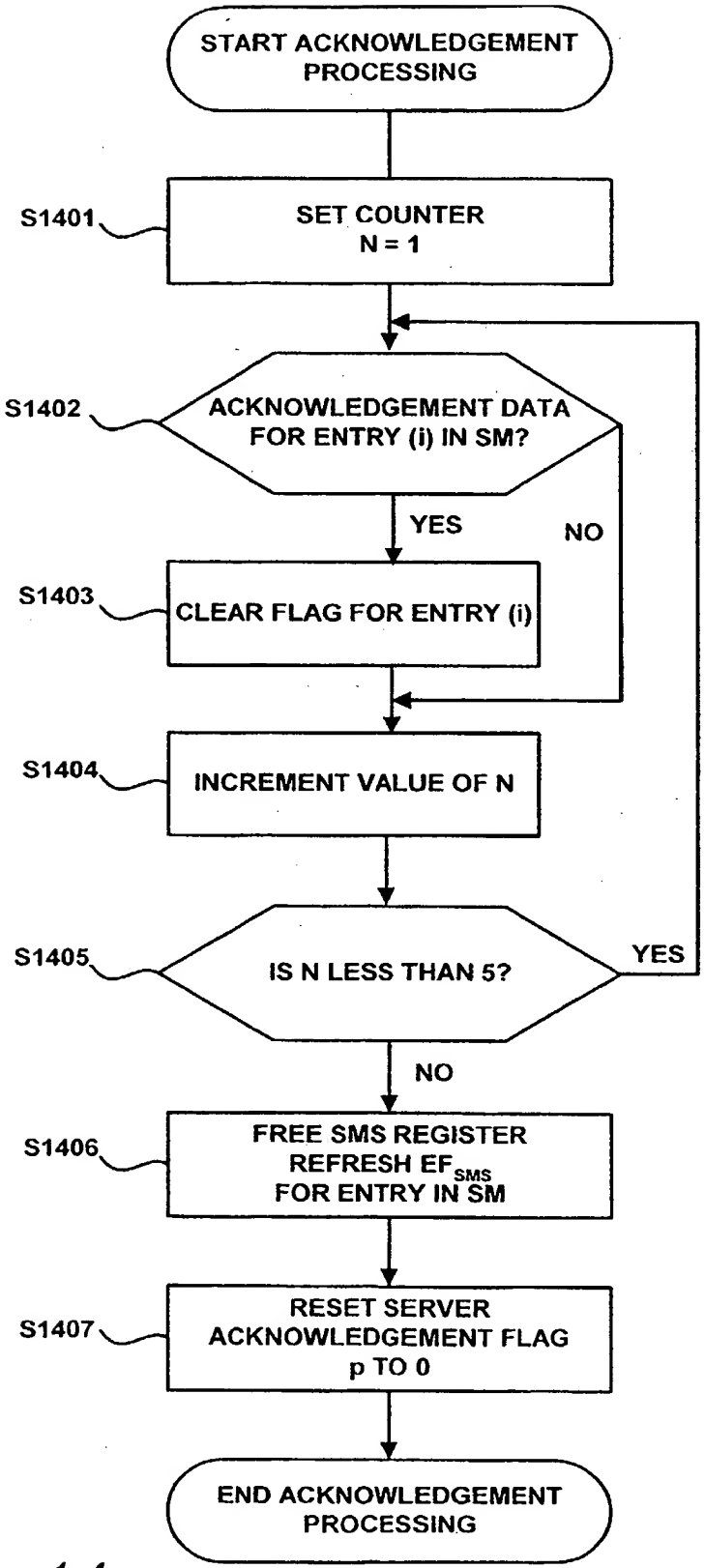

FIG. 14

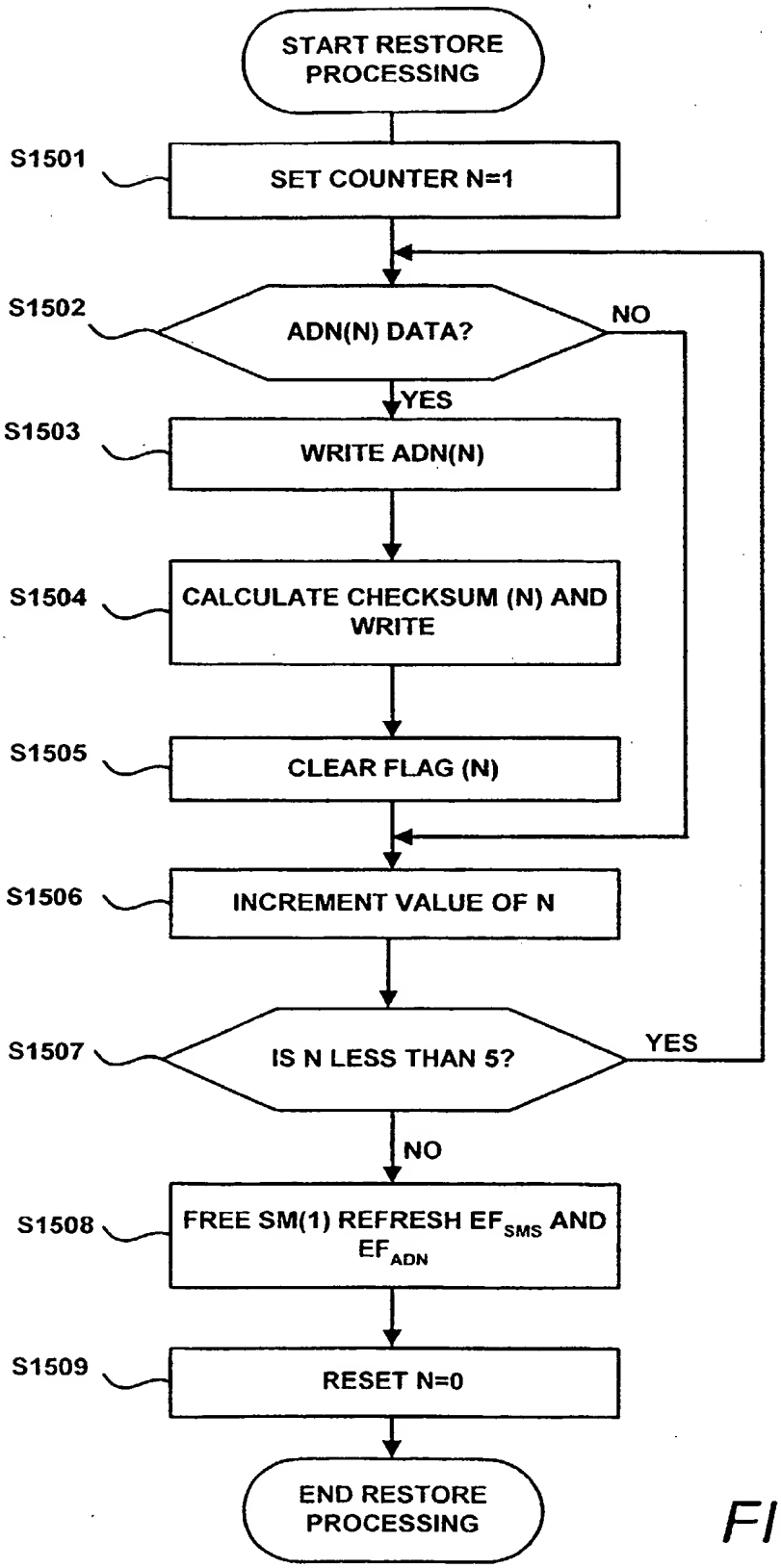

FIG. 15

BACKUP SERVICE ENABLED FLAG	X		
	RECORD 1	RECORD 2	RECORD 3
CHANGES TO BE BACKED UP STATUS FLAGS	X	-	-
CURRENT BACKUP STATUS FLAGS	-	X	-

FIG. 17

DATE/TIME	DIALLING NUMBER	CHARGE	NAME	DISCOUNT
...	...	...	...	...
...	001123456	£2.00	BOB	5%
...	...	...	...	...

FIG. 16

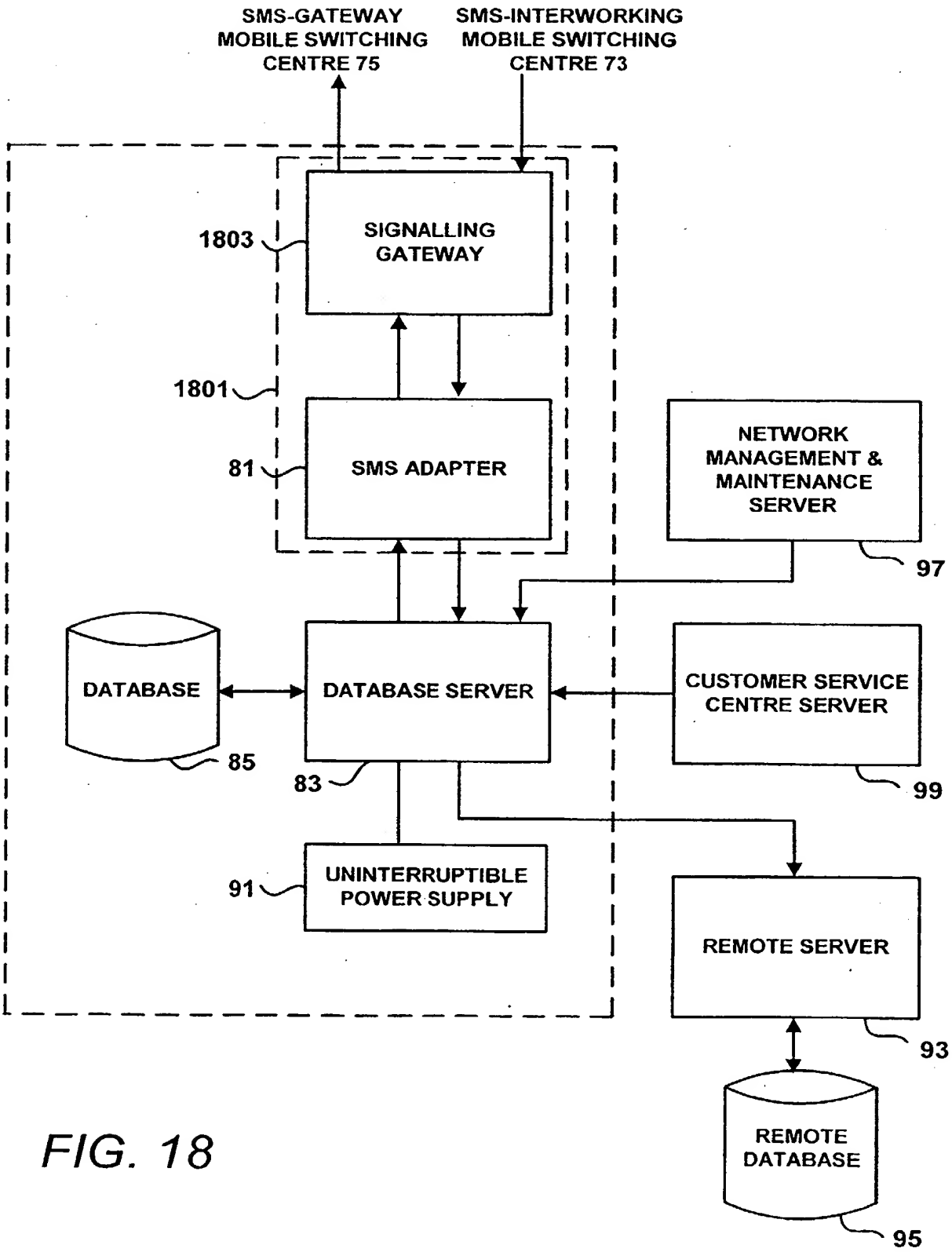

FIG. 18

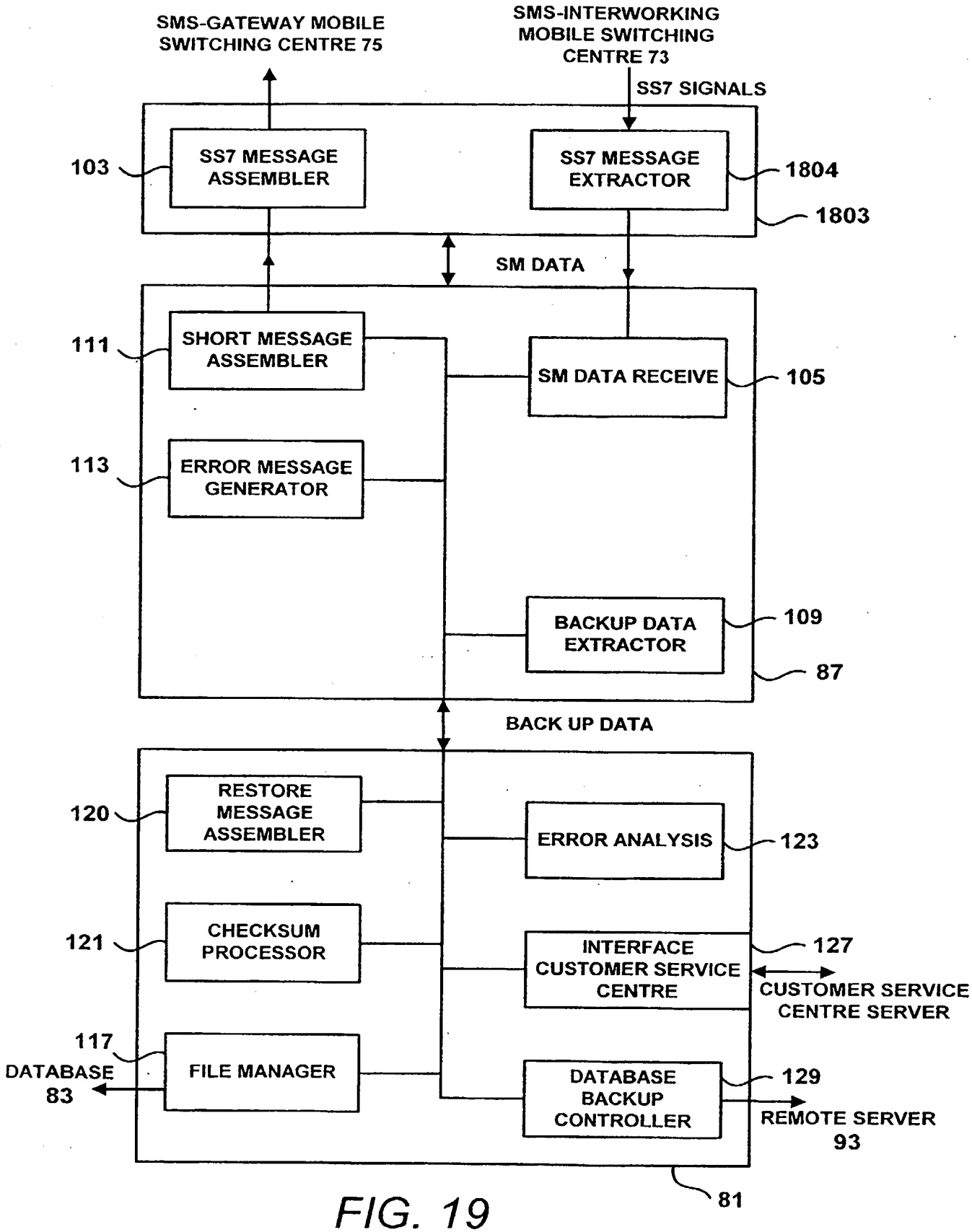

FIG. 19

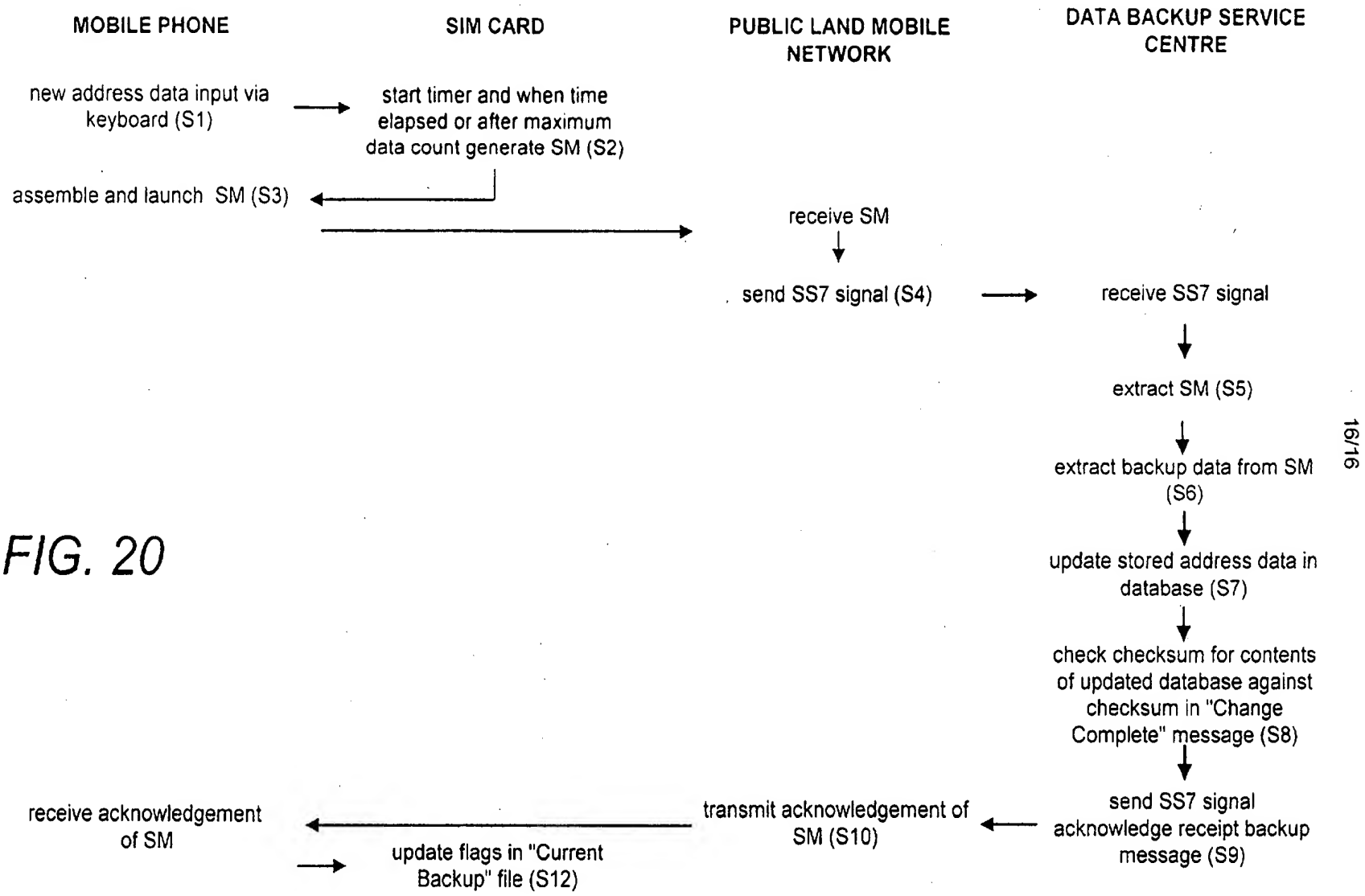

FIG. 20

DATA STORAGE SYSTEM

This invention relates to data storage systems. The invention has particular, although not exclusive, relevance to the backup of data stored on a SIM (Subscriber Identification Module) card in a mobile phone.

A SIM card is a detachable module for a mobile phone, the SIM card being owned by the network operator of a mobile phone communication system and including data specific to the network operator together with data entered by and specific to the user, such as an address book storing abbreviated dialling numbers. When a user decides to obtain a new mobile phone, so as to obtain further facilities for example, the SIM card is removed from the original mobile phone and inserted in the new phone, thus enabling data entered on the SIM card to be used in the new mobile phone. The problem arises that where the SIM card is lost, due to for example loss or theft of the mobile phone, the data recorded on the SIM card will also be lost at considerable inconvenience to the user. Furthermore accidental deletion or corruption of the data recorded on the SIM card is also possible.

It is an object of the present invention to provide a data backup system in which this problem may be overcome.

According to a first aspect of the present invention, there is provided a data backup system for a database comprising: means for updating the database; means for wirelessly transmitting the updated data to a remote data storage system; and means for storing the updated data at the remote data storage system.

In a preferred system, the updated data is automatically wirelessly transmitted to the remote data storage system.

According to a second aspect of the present invention, there is provided a data storage system comprising: means for receiving data from a remote database on update of the information stored in the database; and means for storing the received data.

In one particular application, the data is backup data.

In another particular application, the data is for use in a billing system.

According to a third aspect of the present invention, there is provided a method of updating a database in which, after entry of the data into the database, backup data is wirelessly transmitted to a remote database.

A number of embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is an overview of a data backup system incorporated in a cellular radio communication system;

Figure 2 illustrates the data structure of a message conveying backup information between the mobile station and the data backup service centre of Figure 1;

Figure 3(a) is a schematic illustration of functional modules of software and hardware incorporated in the mobile phone of Figure 1;

Figure 3(b) is a schematic illustration of functional modules of software and hardware incorporated in the SIM card of Figure 1;

Figure 4 illustrates the file structure of the abbreviated dialling code file stored in the SIM card of Figure 3(b);

Figure 5 is a schematic illustration of the functional modules of the backup and restore processing unit incorporated in the SIM card of Figure 1;

Figure 6 illustrates the file structure of the data file used in the backup system;

Figure 7 illustrates schematically parts of the public land mobile network of Figure 1 relevant to the operation of the data backup service;

Figure 8 is a schematic diagram of the architecture of the data backup service centre of Figure 1;

Figure 9 is a schematic illustration of functional modules of software and hardware incorporated in the data backup service centre of Figure 1;

Figure 10 illustrates the data structure of a backup or restore data message;

Figure 11 illustrates the data structure of an acknowledgement data message;

Figure 12 illustrates the processing procedure for monitoring the file to be backed up.

Figure 13 illustrates process steps carried out when a user updates the abbreviated dialling code file stored in the SIM card of Figure 3(b);

Figure 14 illustrates the process steps performed at the SIM card on receipt of an "Acknowledgement" message;

Figure 15 illustrates the process steps performed at the SIM card on receipt of a "Restore" message;

Figure 16 illustrates a bill produced using an itemised billing process in accordance with an embodiment of the invention;

Figure 17 illustrates an alternative backup file configuration used in a second embodiment of the invention;

Figure 18 illustrates an alternative backup service centre configuration used in the second embodiment of the invention;

Figure 19 illustrates the function modules of software and hardware incorporated in the service centre of Figure 18; and

Figure 20 illustrates the process steps performed in the system of the second embodiment of the invention.

OVERVIEW

Referring firstly to Figure 1, this figure illustrates the overall operation of a data backup system in accordance with an embodiment of the invention. In this particular embodiment, data stored on each of a number of mobile stations 1a, b, c may be backed up at a backup data service centre 3. The data to be backed up is transmitted by a wireless link between each mobile station 1a, b, c and a public land mobile network 5, the data then being sent to the backup data service centre 3 via a Short Message Service Centre 6.

Each mobile station consists of a mobile phone 7 in which a respective SIM card 8 is inserted, a radio link being established between an antenna 9 on the mobile phone and an antenna 11 within the public land mobile network 5. Appropriate software modules are incorporated in the SIM card 8 in each mobile station 1a, b, c in order to enable the data backup system to operate as will be described in more detail hereafter.

The data transfer between each mobile station 1a, b, c and the data backup service centre 3 takes place using the point-to-point Short Message service (SMS) facility as defined in part 03.40 of the GSM specification. This SMS facility enables short text messages and other data of up to 140 octets (in the GSM specification 1 octet equals 8 bits) to be sent in a store and forward manner to or from a mobile station in TDMA timeslots other than those used to contain speech data.

The basic format of each SMS message is illustrated in Figure 2. The message starts with transport protocol (TP) data 13 relating to the type, destination and originator of the message as defined in the GSM specification and, as

will be described in more detail hereafter, this information being inserted in a conventional manner for a Short Message by appropriate software modules in the mobile phone 7. The backup data 15 is included as user defined data produced by the SIM card 8, as will also be described in more detail hereafter. On receipt of the SMS message including the backup data, the backup data service centre 3 is able to store a backup version of the data transmitted from the mobile station 1, which in the event of loss of the SIM card, or corruption of the data on the SIM card, may be used to restore the data. The data may also be used for functions other than backup, such as itemised billing, or for enabling downloading of the same data to a number of mobile stations, for example, in the case of a company address book.

The Short Message Service will usually be the class 2 message service, that is where the messages are not displayed on the display of the mobile phone. However the class 1 message service may be used where appropriate signals are transmitted to avoid the display of incoming Short Messages on the display.

The individual components of the data backup system will now be described in more detail.

MOBILE STATION

Referring now to Figure 3, this figure describes schematically the functional modules of software and data incorporated in the mobile phone (Figure 3(a)) and the SIM card (Figure (3b)) in so much as they are necessary to understand the present invention. Further components which are conventionally included in mobile stations, for example for receiving and transmitting speech data, have been omitted for the sake of clarity.

Referring firstly to Figure 3(a), the operation of the mobile phone is controlled by a software control module conventionally known as a phone kernel 21. This controls a radio manager module 22, which in turn controls the transmission of signals to be transmitted by antenna 9 to the public land mobile network 5, or the processing of signals received by the antenna 9 from the public land mobile network 5.

An SMS reception unit 23 is arranged to process incoming SMS signals dependent on data within the transport protocol 13 to display the message on a display (not shown) under the control of a display control unit 24 when the SMS data contains a conventional Class 1 Short Message including a text message. Alternatively, where it is determined that the incoming SMS signal includes information relating to the SIM card 8, such as information relating to backup data transfer to the backup service centre 3, or, in the case of a data restore operation, data downloaded from the backup service centre 3, a SIM manager unit 25 within the mobile phone 7 is arranged to pass appropriate signals to an interface on the SIM card 8 as will be described in more detail hereafter.

The mobile phone 7 also includes an SMS assembly unit 26 which is arranged to incorporate appropriate GSM transport protocol data in SMS messages to be transmitted through the antenna 9 under the control of the radio manager 22.

A keyboard (not shown) enables a user to input instructions to a keyboard interface 27 which is effective to interpret the instructions and distribute appropriate signals within

the rest of the mobile phone. A clock 28 is effective to produce timing signals for use by the mobile phone 7 and to produce polling signals which are sent to the SIM card 8. Finally, the phone is provided with an area of RAM 29 effective to store, amongst other data, a copy of abbreviated dialling numbers and a copy of the incoming SMS messages which are sent to the SIM card 8 as will be described in more detail hereafter.

Turning now to Figure 3(b), the operation of the SIM card 8 is controlled by control software conventionally called a SIM kernel 31. A data communication protocol unit 32 is effective to receive and to transmit signals to or from the mobile phone 7. A card holder verification processor 33 is programmed with security data for verifying the authenticity of a security number (CHQ) derived from the PIN number typed in using the keyboard by the user on switching on the mobile phone in order to verify the identify of the user.

The SIM card 8 also includes a file manager 34 effective to control the input and output of data into a number of files stored within an EEPROM memory 35 on the SIM card 8. These

files include a number of so-called "elementary files" including an abbreviated dialling numbers file EF_{ADN} 36 and a file EF_{SMS} 37 for storing the latest incoming SMS messages. The elementary files also include other elementary file data such as preferred networks, the dialling numbers of recent calls, etc, but these have been omitted from the drawing for the sake of clarity.

The EEPROM 35 also includes a buffer area 38 called a SMS transport protocol data unit (SMSTPDU) for storing SMS data prior to transfer to the mobile phone 7 as will be described in more detail later.

Turning now to Figure 4, this figure shows the basic structure of the abbreviated dialling numbers file EF_{ADN} 36. This file structure data is in accordance with the GSM specification GSM 11.11. Each entry has an entry number i and includes a so-called "Alpha Identifier" giving some form of identification for the particular number specified by the user, for example "BOB" or "HOME". The next field includes the length of the data in the entry followed by the type of telephone number, for example, whether the number includes International dialling codes. The dialling

number then follows, followed by information relating to the network operator and a final field identifying whether the entry overflows onto another record, and if so, the location of the other record. The overall length of each entry can be up to 254 bytes, but will typically be 30 bytes. Typically, a private user will have 30 entries in the EF_{ADN} file, although up to 100 entries can usually be accommodated.

As so far described, the SIM card is of conventional form. However, to enable the backup of data stored, for example, in the abbreviated dialling number file EF_{ADN}, the SIM card also includes an additional software module comprising a backup and restore processing unit 41 which will be described in more detail hereafter. This is incorporated in the SIM card 8 as an Applet either during manufacture of the SIM card or as a download during operation of the SIM card. The backup and restore processing unit 41 cooperates with the other functions on the SIM card via the SIM Application Tool Kit 43 which is conventionally included in SIM cards and includes a set of commands and procedures which enables applications existing in the SIM card 8 to interact and to cooperate with applications in the mobile

phone, or the network.

The features of the SIM application tool kit 69 are defined in GSM Standard 3GPPTS 11.14 and in particular include a "Send Short Message" function 45 enabling the SIM card 8 to send data for incorporation in a Short Message to the mobile phone 7 and a poll signal control unit 47 effective to change the frequency of the polling signals which are produced by the clock 45 on the mobile phone 7.

In particular, the poll signal control unit 47 is used to cause the clock 45 to send polling signals at five second intervals during the "idle" period for the phone 7 following times at which the display on the phone has been refreshed, this being a time when the SIM card is usually inactive. The interval of five seconds is chosen as being a time which the user of the mobile phone is likely to find unobtrusive, although other time intervals may be chosen to suit the particular circumstances.

In addition to the backup and restore processing unit 41, the SIM card 8 is provided with backup files 49 in the EEPROM memory 35 for monitoring the backup procedure as

will be described in more detail hereafter.

Referring now to Figure 5, this figure illustrates the functional units included in the backup and restore processing unit 41. The unit 41 is controlled by an event manager 51 which reacts to either:

1. incoming Short Messages received from the mobile phone 7 which have been determined as including information relating to the backup service, or

2. polling signals received from the clock 28 on the mobile phone 7.

In particular, the event manager 51 controls the functioning of an incoming message manager 53 arranged to handle incoming Short Messages which have been determined as including information relating to the backup service and a scheduler 55 responsive to the polling signals. The event manager 51 is arranged such that the incoming Short Messages always have priority over the polling signals.

The incoming message manager 53 is arranged to analyse the

contents of the information within the incoming Short Messages to determine whether the information is for:

1. a service state manager 57 in the event that the information includes "ON"/"OFF" state messages, that is, whether the backup service should be switched "ON" or "OFF",

2. a restore manager 59 in the event that the message includes restore information, or

3. an acknowledgement manager 61 in the event that the information includes acknowledgement information as to whether a successful backup operation has taken place.

Where there is no incoming Short Message, on receipt of a polling signal by the event manager 51, the scheduler 55 determines whether any backup processing has to be performed and, if so, allocates the time slot to a backup manager 63. In the event there is no outstanding backup to be performed, the scheduler allocates the time slot to an "idle" processor 65 whose function is to interrogate the backup file 49 stored in the EEPROM memory 35 to determine

whether the EF_{ADN} file requires backing up. A brief description of the backup file 49 and the "idle" processing will now be given.

Referring now also to Figure 6, this figure illustrates the form of the backup file 49 stored in the memory 35. In respect of each EF_{ADN} entry as illustrated in Figure 4, the backup record stores a 16 bit checksum calculated from the EF_{ADN} data for that particular record. During the "idle" processing, the checksum based on the EF_{ADN} data for the entry is re-calculated and compared with the stored checksum. A "change" flag is then set dependent on whether the checksum is the same as the stored checksum. Thus, in Figure 6, the checksum for record "BOB" has changed indicating that the EF_{ADN} data for record "BOB" has changed since the entry was last backed up.

The interaction between the various backup, "idling", restore, and acknowledgement processing will be described in more detail later.

PUBLIC LAND MOBILE NETWORK

The basic features of the public land mobile network (PLMN) 5 will now be described in only as much detail as necessary to describe the transmission of a Short Message between the mobile station 1 and the data backup service centre 3.

Referring now to Figure 7, the PLMN 5 includes a base transceiver station (BTS) 67 effective to establish a radio link between the mobile station 1 and the PLMN 5. The BTS 67 operates under the control of a base station controller (BSC) 69. The BTS 67 serves a geographical area constituting one cell of a cellular communication system, the mobile station 1 being located within this cell. It will be appreciated that, whilst in Figure 7 only one BTS 67 is shown, other BTSs under the control of the BSC 69 will be provided with a PLMN 5, each BTS being effective to establish a radio link with mobile stations in different geographical areas or cells.

The BSC 69 is connected through a mobile switching centre (MSC) 71 to an SMS-Interworked Mobile Switching Centre (SMS-IWMSC) 73 effective to direct Short Messages to the

data backup service centre 3 and an SMS-Gateway Mobile Switching Centre (SMS-GMSC) 75 effective to receive Short Messages from the data backup service centre 3. The SMS-GMSC 75 is also connected to a home location register (HLR) 77 effective to store subscriber information for the network relating to which services any particular mobile station is registered. A visitor location register (VLR) 79 is connected to the MSC 71, the VLR being effective to determine the state of the mobile station to which a message is to be sent, and in the event that the mobile station is switched off, to hold the message until it is possible to transmit the message when the mobile phone 7 is next switched on.

DATA BACKUP SERVICE CENTRE

Referring now to Figure 8, this figure illustrates the components of the data backup service centre 3. An SMS adaptor 81 is arranged to perform an interface to incoming and outgoing messages from the Short Message Service Centre 6, the messages being conventionally transmitted as SS7 signals. The adaptor 81 is connected to a database server 83 which in turn is arranged to address database 85.

In order to provide as resilient a service as possible, the database server 83 is provided with an uninterruptable power supply 87 and is configured with suitable disc redundancy, the database 85 being designed to be backed up on a regular, generally daily basis. In addition, the database 85 is provided with a hardwired link to a remote server 89 provided in a different site which is arranged to address a remote database 91, this enabling a copy of the data within the database 85 to be made to protect against the possible catastrophic destruction of the site in which database 85 is located. Inputs to the database server are also provided from a web server 93, a billing system processor 95 and a customer service centre server 97.

Referring now also to Figure 9, this figure illustrates in more detail the functional software modules within the SMS adaptor 81 and the database server 83.

The SMS adaptor 81 includes a unit 105 effective to receive the Short Message data produced by the Short Message Service Centre 6 and a backup data extractor 109 effective to extract the backup data from the message and send this to the database server 83. The SMS adaptor 81 also includes a Short Message assembler 111 effective to receive

data signals from the database server 83 and assemble them in a Short Message and send Short Message data to the SS7 message assembler 111, and an Acknowledgement message generator 113 effective to generate Acknowledgement messages for incorporation in Short Messages assembled by the Short Message assembler 111.

The database server 83 includes a file manager 101 for controlling the entry of data into the database 85. The database server 83 further includes a restore message assembler 103 for assembling restore data to be transmitted back to the mobile station 1 in the event of a restore operation. The server 83 further includes a checksum processor 105 effective to produce a checksum on data backed up by the database 85 and an error analysis processor 107 effective to analyse errors occurring in received backup data so as to enable error messages to be sent back through the system to the mobile station 1, or for the backup service system operator to be alerted.

Finally, the database server 83 includes interfaces 109 for the customer service centre server 97 and a database backup controller 111 for interaction with the remote server 93.

DATA STRUCTURE OF THE SMS SIGNAL INCLUDING BACKUP DATA

More details of the Short Message format illustrated in Figure 2 will now be given.

The transport protocol data 13 at the start of the SMS message is determined by transport protocol (TP) data specified in GSM 03.40, and in the particular case illustrated in Figure 2 includes as a minimum the following data fields:

Table 1

REFERENCE	DESCRIPTION
TP-Message-Type-Indicator	Parameter describing the message type, i.e. a SM as transmitted by a mobile station.
TP-Reject-Duplicates	Parameter indicating whether or not the Backup Data Service Centre shall accept an SMS message for a Short Message still held in the Service Centre as a previously submitted Short Message.

TP-Validity-Period-Format	Parameter indicating whether or not the TP-VP field is present.
TP-Reply-Path	Parameter indicating a request for a Reply Path.
TP-Message-Reference	Parameter identifying the ISDN number of the mobile station.
TP-Destination-Address	Parameter identifying the ISDN number of the Backup Data Service Centre.
TP-Protocol-Identifier	Parameter identifying the layer protocol, if any.
TP-Data-Coding-Scheme	Parameter identifying the coding scheme within the backup data.
TP-User-Data-Length	Parameter including the length of the backup data to follow.

This data includes the address of the backup data service centre such that the network is able to send Short Messages originating from the mobile station 1 to the data backup service centre 3 via the Short Message service centre 6. The transport protocol also indicates the length of the backup data to follow.

Turning now to the form of the backup data included in the SMS message, a typical data structure is shown in Figure 10. Each set of backup date comprises 117 bytes of which

the first byte is a message ID, that is, a parameter identifying that the message includes backup data. The remaining 116 bytes comprise four sets of 29 bytes of which the first byte corresponds to the abbreviated dialling number record number i and the next 28 bytes comprises the abbreviated dialling number EF_{ADN} data entry as indicated in Figure 4. Where the record number is set at zero, this indicates that the following data fields are empty.

The backup data structure will also be used in Short Messages transmitted during restore processing where information is being received by the mobile station 1 from the backup service centre 3. In this case, the ID identifier at the beginning of the data will indicate that the data is restore data.

Backup operations are completed by receipt by the mobile station 1 of a Short Message including acknowledgement data of the form indicated in Figure 11. This data structure comprises nine bytes commencing with an ID byte indicating that the data is acknowledgement data and then four sets of two bytes. The first byte in each pair of bytes comprises the record number i of the EF_{ADN} data, whilst the second

byte indicates whether the latest backup operation has been successful or not. Where the first byte in each pair is set at zero, this indicates that the following data field is empty.

OPERATION OF THE DATA BACKUP SYSTEM

1. "Idle" Processing

Referring now to Figure 12, as mentioned above, in the absence of an incoming Short Message during the "idle" processing, the backup file 49 illustrated in Figure 6 is interrogated to determine whether any of the EF_{ADN} data entries have been changed since the last backup procedure and thus require backing up. The "idle" processing is designed to take place in time slots of less than five seconds, that is, less than the time intervals between the polling signals received from the mobile phone. Thus, it will take many "idle" processing sessions to complete the interrogation of a typical abbreviated dialling number address book of 100 entries.

At the start of the "idle" processing procedure in step

S1201, the count j of the number of entries stored in the current backup Short Message SM(1) stored in the SMS transport protocol data unit (SMSTPDU) buffer 38 is investigated within the scheduler 55 and it is determined whether count j, that is the number of backup data entries waiting to be sent stored in the buffer 38, is less than 4, that is, whether the maximum number of backup data entries has been incorporated in the current Short Message. If the count j has reached 4, it is then determined in step S1202 whether the count n indicative of the time since a backup message was last sent, that is the time since j became greater than 0, is less than 20. If n is less than 20, then "idle" processing proceeds. Alternatively, if j has reached 4 or the count n has reached 20, that is a "time out" condition is fulfilled, the processing switches to backup processing as will be described in the next section.

In the event that the "idle" processing procedure does continue using the "idle" processor, the entry number (i) of the address book entry is incremented in step S1203 to determine the entry number i which is going to be interrogated.

In step S1204, it is determined whether the count j is greater than zero, that is, there is backup data waiting to be sent stored in the buffer 38, and if so, the counter n indicative of the time since a backup message was last sent is incremented in step S1205. In step S1206, it is determined whether the entry number i is equal to 100, that is, whether the end of the file has been reached on the assumption that there will be a maximum of 100 entries in the EF_{ADN} file and, if so, in step S1207 the entry number i is reset to 1 to restart the reading of the entries in the backup file 49.

In step S1208, it is determined whether the abbreviated dialling number data entry for entry i is, in fact, empty. If the entry is not empty, the checksum CHQ(i) is calculated in step S1209 and, in step S1210, CHQ(i) is compared with the checksum for entry i stored in backup file 49.

Referring now also to Figure 6, in the event that the calculated checksum CHQ(i) is different to the stored checksum, the change flag in the backup file 49 is set to 1 indicating there has been a change in the entry resulting

in the change to the checksum for the entry. The current data for the entry is added to the SMS transport protocol data unit (SMSTPDU) buffer 38 in the EEPROM 35 and the count j of entries in the current Short Message is incremented in step S1213.

2. Backup Processing

The backup processing procedure is illustrated in Figure 13. In step S1301, the Short Message including backup data structured as shown in Figure 10 and stored in buffer 38 is transmitted via the mobile phone 7 and the Short Message service centre 6 to the data backup service centre 3. At the data backup service centre 3, the backup data extractor unit 109 is arranged to extract the backup data, the file manager 101 within the server 83 being arranged to overwrite the appropriate data in the database 85.

In step S1302, the buffer 38 storing the current Short Message SM(4) in the SIM card is cleared and in step S1303 the appropriate flag and counters are reset. In particular, the server acknowledgement flag p is set to 1 indicating that an acknowledgement message from the data

backup service centre 3 is pending. The counter j indicating the number of pending backup data messages in the current Short Message stored in the buffer 38 is set at zero and the counter n indicating the elapsed time since j was greater than zero is also set to zero.

This then completes the backup processing at the SIM card 8 until the next "idle" processing takes place which initiates the next backup processing.

It will be appreciated that whilst the above describes the basic processes performed in assembling and transmitting the SMS message including the backup data, there are various other possibilities. In particular, the backup data may undergo compression in particular by the backup manager 63 before transmission of the backup data. This may be particularly appropriate where the ADN data includes a number of blank fields. Encryption may alternatively or additionally be performed.

3. Acknowledgement Processing

Following a backup operation, the change flags P for each

backed up entry in the backup file 49 are not reset until receipt of an acknowledgement message from the backup service centre 3. The acknowledgement messages are of the form indicated in Figure 11.

In acknowledgement processing by acknowledgement manager 61, following receipt of an acknowledgement message in step S1401, a counter N is set to 1. It is then determined from the first byte following the ID byte within the acknowledgement data message whether the entry includes acknowledgement data for the designated entry number i in step S1402. If the following acknowledgement data in the subsequent byte is positive, the change flag P is cleared for the designated entry in step S1403. As the acknowledgement processing is arranged that acknowledgements can be processed for four entries in the five second time slot provided by the polling signals, the value of N is incremented in step S1404 and where the incremented value of N is less than 5, the process steps S1402-S1404 are repeated.

After all the data in the Acknowledgement message has been processed, in step S1406, the register for the incoming

Short Message in file EF_{SMS} 37 is freed. A command is sent to the phone 7 via the data communication protocol unit 32 to refresh the corresponding incoming SMS entry in the RAM 29 in the phone 7. In step 1407 the server acknowledgement flag p is set to zero to indicate that no acknowledgements are pending.

There are various stages at which it may be determined that for some reason successful backup has not taken place. In the first instance, due to transport errors, the network 5 may not receive the transmitted message from the mobile station 1. Alternatively, the non-backup may be due to faulty transmission of the data within the transmitted Short Message. This will generally be picked up by the checksum processor 121 in the database server 83. In either event, the failure of the SIM card 8 to receive a positive acknowledgement signal will cause the server acknowledgement pending flag to remain at "acknowledgement pending" and the "change flags" in the backup files to remain set at "change" such that the backup data for the relevant entries will be re-transmitted to the backup service centre 3 when the entry for the backup file is interrogated during "idle" processing.

In a variation of this procedure, in the case of faulty data transmission, the error message generator 113 can be programmed to produce a control message in the form of a resynchronisation request which is assembled in a Short Message by the Short Message assembler 111 such that a Short Message is transmitted to the mobile station 1. Reception of this message will alert the backup manager 63 in SIM card 7 to transmit a series of Short Messages replicating the ADN data currently stored in the SIM EF_{ADN} files 36 to enable the two databases to be resynchronised.

Further error analysis may take place within error analysis unit 107 within the database server 83 where it is determined for example that the ADN data of an updated record is totally incompatible with data already stored on the database 83 or where it is determined that the user does not have a valid account with the data backup service. This will usually result in a message being sent to the user initiated by the customer service centre server 97 either via e-mail or some other form of communication.

4. Restore Processing

In the event that the user requires restoration of the EF_{ADN} data stored on the SIM card 8, due to, for example, loss of the SIM card or corruption of the data, this will normally be dealt with by the user contacting the customer service centre. An appropriate message will be sent through the customer service centre server 97 to the database server 83 to instigate the restore process either for all entries, or for a selected group of entries. In the event of the loss of the SIM card, this may conveniently be achieved by download of the data stored on the database 85 to a SIM manufacturer who is able to load the data.

Alternatively, the ADN data may be incorporated in a number of Short Messages using the Short Message assembler 111 in the SMS adaptor 87, the data being transferred via the network 5 within an appropriate number of SMS "restore" messages of the form shown in Figure 10 so that all the data in the abbreviated dialling number file EF_{ADN} is transmitted as will now be described with reference to Figure 15.

Before restore processing takes place, the restore manager 59 is effective to check the transmitted data against the checksum incorporated in the transmitted restore data. If there is a discrepancy, a suitable warning signal is sent back to the backup service centre 3.

In restore processing, even where all the abbreviated dialling number entries must be restored, there being typically 100 such entries for a domestic user, the restoration takes place four entries at a time, this being determined by the available space capacity of an SMS message. In step S1501, a counter N is set to 1. It is then determined in step S1502 whether the first entry in the restore data will be of the form indicated by Figure 10. The abbreviated dialling number entry ADN(N) is written into the backup file 49 in step S1503, the checksum is calculated and written in the backup file 49 in step S1504 and the flag P in the backup file 49 is set to zero in step S1505.

In step S1506, the value of N is incremented and in step S1507, where it is determined that the incremented value of N is less than 5, the process steps S1502-S1506 are

repeated.

After four cycles, all the data within a single Short Message will be restored in the EF_{ADN} file 36 in the SIM card 8. In step S1508, the current incoming Short Message SM(1) in the elementary file EF_{SMS} 37 is freed and the corresponding entries in the abbreviated dialling number file and the incoming Short Message file in the RAM 29 in the mobile phone are refreshed. Finally, in step S1509 the counter N is set to zero.

It may be arranged that the mobile phone display displays a message to the effect that successful restoration has taken place.

OTHER USES OF THE BACKUP SYSTEM

It will be appreciated that the above backup restore system also gives the possibility of providing further functionality to the mobile station 1 either in addition, or as an alternative, to the backup of data. In particular, the storage of the backup data at the backup service centre 3 enables the possibility of itemised

billing as indicated in the bill shown in Figure 16. As the database 85 at the backup service centre 3 includes complete abbreviated dialling number files, this may be accessed by the billing system processor 95 such that numbers phoned by the mobile station 1 such as that of "BOB" may be identified on the bill. Where this number is pre-registered as a preferred number, this may then appear with a discount on the bill.

It will also be appreciated that the data stored in the backup centre may be used to enter a series of abbreviated dialling numbers, or other data, to a number of different mobile stations. This may be particularly useful in the downloading of a company address book.

ALTERNATIVE EMBODIMENT

In an alternative embodiment to be described, the data message structures are generalised to enable different data to be backed up, the backup processing is initiated by entry of new ADN data on the keyboard of the mobile phone, and the data backup data service centre acts as a Short Message service centre. It will be appreciated, however,

that each of these features may be incorporated separately in the first embodiment described above.

1. Alternative Data Structure

In the example described above, each Short Message includes data for a maximum of four EF_{ADN} entries. In an alternative embodiment, the data structure may be more generalised to allow adaptation to backup of different data and different message lengths. Assuming that more ADN data is to be included that will fit into a single Short Message, the data will be included in a series of "Change" messages, the final set of data being included in a "Change Complete" message. The form of each "Change" message is shown in Table 2.

Table 2

REFERENCE	DESCRIPTION
Message ID	Parameter identifying that the message includes backup data.
Protocol Version ID	Parameter identifying the structure of the message.
Data Type	Parameter identifying the type of data, i.e. ADN data.

ADN data	Each set of ADN data, each set containing a tag which identifies the field of data, the length of the data in the field, and a value for the data.

This message will be followed by a "Change Complete" Short Message including error control data as set out in Table 3.

Table 3

REFERENCE	**DESCRIPTION**
Message ID	Parameter identifying that the message includes backup data.
Protocol Version ID	Parameter identifying the structure of the message.
Data Type	Parameter identifying the type of data, i.e. ADN data.
Check Data	Checksum over all the ADN data stored in the updated ADN files 63 in the SIM card 7.
ADN data	Final set of ADN data of the format described in Table 2.

It will be appreciated that the above data is specifically indicative of backup data transmitted by the mobile station 1 through the network 5 to the data backup service centre 3.

Further messages such as error messages and control messages may also be transmitted through the system. These will, however, generally include similar transport protocol (TP) data indicated above, although the data backup service centre 3 may initiate the signal. The data format within the control messages will be as set out in Table 4.

Table 4

DESCRIPTION	CONTENT
Message ID	Parameter identifying that the message includes backup data.
Protocol Version ID	Parameter identifying the structure of the message.
Request	Type of Request.

The type of request will include the requesting of a restore operation, or a database resynchronisation operation.

2. Alternative Instigation of Backup Processing

In the first embodiment described above, backup processing is instigated by monitoring the backup file to detect changes during "idle" processing. In an alternative

embodiment, a command structure 73 may be programmed within the SIM kernel 51 to provide "prompt" signals on the entering of abbreviated dialling number data through the keyboard of the mobile phone 7 which notify the Applet forming the backup and restore processing unit 41 that APDU (Application Protocol Data Units) data for updating the EF_{ADN} file has been received from the mobile phone 7.

Referring now to Figure 17, this figure illustrates the backup service monitor files 71 which are stored in the memory 61 of the SIM card 8 in such an alternative embodiment. In particular, the backup file 49 is substituted by a "changes to be backed up" file including a set of flags for each ADN record in the abbreviated dialling numbers file 36 indicating whether a user has input any changes to the record using the keyboard. Finally, a further file comprises a "Current Backup" file including flags for each record for indicating whether any changes have been made and have been included in the last backup data message which is currently in the buffer 38 or being transmitted by the mobile phone.

3. Alternative System Configurations

In this further embodiment, the data backup service centre 3 is arranged to act as a Short Message Service Centre located on the same site as the network operator's site, but located in an access controlled premises.

Referring now particularly to Figure 18, in which corresponding components to those in Figure 8 are correspondingly labelled, in order that the data backup service centre 3 can be made compatible with different network technologies, the data backup service centre 3 is divided into two sets of components:

1. A database server 83 and associated database 85.

2. A network adaptor 1801 comprising an SMS adaptor 81 and a signalling gateway 1803.

It will be appreciated that in practice all the above components may be constituted by software running on the same hardware, in which case the interfaces between the various components may be software components. However, in

some situations it may be appropriate for the signalling gateway 1803 to be constituted by software running on a separate piece of hardware to that on which the SMS adaptor 81 is constituted. In this case, the interface between the signalling gateway 1803 and the SMS adaptor 81 may be a TCP-IP hardware interface, or alternatively a software interface.

The signalling gateway 1803 is connected via physical links, for example, coaxial cables to the SMS-Gateway Mobile Switching Centre 75 and the SMS-Interworking Mobile Switching Centre 73 so as to be effective to receive SMS signals from the SMS-Interworking Mobile Switching Centre 73 and to transmit SMS signals to the SMS-Gateway Mobile Switching Centre 75. The signals are transmitted between the public land mobile network 5 and the signalling gateway 89 using a conventional common channel signalling system 7 (SS7) which incorporates signalling protocol inserted within the network. As is conventional for data transfer E1 frame format SS7 signals are used, this having a maximum bit rate of 2.048 Mbps.

Turning now also to Figure 19, this figure describes in

more detail the functional components of the signalling gateway 1803 where the backup service centre 3 forms a Short Message Service Centre.

The signalling gateway 1803 includes a Short Message extractor 1804 effective to receive SS7 signals transmitted by the IWMSC 73, to terminate the SS7 signalling protocol and to produce Short Message based data for onward transmission to the SMS adaptor 81. The signalling gateway 1803 further includes a SS7 message assembler 103 effective to receive Short Messages produced by the SMS adaptor 81, add SS7 signalling protocol and transmit the SS7 signals to the SMS-Gateway Mobile Switching Centre 75 within the network 5.

4. System Processing of Second Embodiment

Figure 20 illustrates various steps performed in the mobile station 1 (either by the mobile phone 7 or the SIM card 8) the public land mobile network 5 and the backup service centre 3 during successful backup of changes to the abbreviated dialling code address book by a user entering data through the keyboard of the mobile phone 5 following

receipt of a "Change Complete" message by the backup service centre 3 where backup processing is instigated by "prompt" signals.

In step S1 user entry of keyboard data through the keyboard interface 27 is effective to cause the SIM manager 25 in the mobile phone 7 to produce appropriate signals (so called "application protocol data units" (APDU)) to the data communication protocol unit 32 within the SIM card 7. Through the data communication protocol unit 32, the SIM card 8 is able to identify that the data signals refer to updates in the abbreviated dialling number file, EF_{ADN}, and that records within an EF_{ADN} file are to be updated.

In step S2, in response to the data signals identified as being update signals to the EF_{ADN} file, a PROMPT signal is generated in the SIM kernel 31 which is effective to initiate the backup manager 63. This sets up the flags in the "Changes to be backed up" file illustrated in Figure 17, the first record being amended in the particular example being illustrated. Using an "OR" operation to transfer the information, the flag data in the "Changes to be backed up" file is copied into the "Current Backup

Status" file such that the amendment to record 1 is added to an existing amendment to be made to record 2 and the "Changes to be made" flags are reset. The ADN data for each entry 1 and 2 is then temporarily stored in the buffer 38 within the EEPROM 35, the data being organised in each "Change" message as indicated in Table 2 to include a message ID, the modified ADN data and, in the final "Change Complete" message as indicated in Table 3 a checksum in order to enable error control to be performed.

The data is sent via the data communication protocol unit 32 to the mobile phone 7 for inclusion in an SMS message including the transport protocol shown in Table 1 by the SMS assembler 26. When either the total amount of possible data has been incorporated in the data field 15 shown in Figure 2 or after a predetermined amount of time, the predetermined amount of time is compared with timing signals derived from the clock 28 within the mobile phone 7 to measure the time from which the user started entering the updated ADN data. The mobile phone is then arranged to transmit the Short Message through the antenna 9 during one or more unused time slots, further Short Messages following if necessary to incorporate all the new or updated ADN data

(step S3).

Whilst the above description has described the initiation of the backup data transmission in response to the entering of data by a user through the keyboard on the mobile phone, it being efficient to include a time delay before an SMS data backup signal is transmitted in order to incorporate as far as is possible all the changes made by the user at a particular time, other ways of initiating the backup process are possible. In particular, the timer may not be used and the transmission of data may be dependent only on the entry of a minimum number of changes. This would avoid a potential problem in some particular mobile stations in that the user may turn the mobile phone off before backup has taken place. Alternatively, the system may be arranged so as to enable the backup to take place in response to polling signals received from the data backup service centre rather than from the mobile phone.

On reception of a Short Message by the base transceiver station 67 within the public land mobile network 5, the mobile switching centre 71 in the network 5 will derive the address of the backup data service centre and route the

signal bearing the Short Message to the appropriate SMS-Interworking Mobile Switching Centre 73. The SMS-Interworking Mobile Switching Centre 73 is effective to incorporate the incoming Short Message in appropriate SS7 transport protocol and to transmit the resultant SS7 signal to the signalling gateway 89 within the data backup service centre 3 (step S4).

In step S5, the SS7 message extractor 101 of the signalling gateway 1803 is effective to remove the SS7 protocol, and transfer data representative of the Short Message to the SMS adaptor 81.

The backup data extractor 109 extracts the ADN data from the backup data 15 within the Short Message together with an indication of the ISDN number for the particular mobile station, thus identifying the particular mobile station account holder and sends this data to the database server 83 (step S6).

The database server is effective to check the ISDN number of the mobile station from which the Short Message has originated against the account information held in the

database 85 to determine whether the user of the mobile station has actually subscribed to the data backup service. Assuming that this is the case, the data for the particular user is identified within the database 85 and it is determined using the ADN record number whether the received ADN data is a modification to existing records within the database or whether the data is new data. The records in the database 85 are accordingly either overwritten or newly entered (step S7). The data could of course be identified in some other way than by the ADN record number.

On receipt of the final "Change Complete" message, the checksum processor 121 performs a checksum analysis over all the data now stored in the database 85 and checks this against the checksum for the ADN data stored in the SIM card as included in the "Change Complete" message to ensure that the backed up ADN data replicates the stored data in the SIM card (step S8).

At this point a notification that successful data backup has taken place is sent to the data originating mobile station 1 via the SS7 message assembler 103 and the network 5 (steps S9 and S10).

On acknowledgement of a successful backup operation, the flags in the "Current Backup File" in the backup files 71 are then reset.

In the absence of an appropriate confirmation that the backup has successfully taken place or the reception of an error message, the flags in the "Current Backup" file provide a further safeguard for retrieval of data which must be backed up. As the flags in the "Current Backup" file are not reset until receipt of a positive confirmation that successful backup confirmation has taken place, backup data corresponding to entries in respect of which no confirmation has been received is then automatically included within the backup data message next time a user initiates the use of the backup system by entry of address data amendments through the keyboard.

It will be appreciated that whilst a checksum arrangement has been described to give some protection against faulty data transmission, other forms of error detection may be used.

ALTERNATIVE SIGNALLING SYSTEM CONFIGURATIONS

Whilst the backup of data using the Short Message service as the transfer means for transmission of data between the mobile station and the public land mobile network 5 is particularly convenient as, at present, use of the Class 2 Short Message Service (i.e. Short Messages which are not displayed on the display of the mobile phone) is free to the user, it will be appreciated that there are other ways in which the data may be communicated between the mobile station 1 and the data backup service centre 3, In particular, the transfer may take place by means of transfer of unstructured supplementary service data (USSD). Alternatively, data packet switching may be used, or in WAP enabled mobile stations, an Internet connection.

It will also be appreciated that whilst the invention is particularly appropriate to the backup of abbreviated dialling number data on a SIM card in a mobile phone, the invention may also be used to backup other data, particularly on a number of mobile stations. This may be other data stored on either the SIM card or within the mobile phone within a mobile station. Alternatively, the

data backup/restore service may be used to backup and restore other data, for example within a personal computer or a personal data apparatus.

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CLAIMS

1. A data backup system for a database comprising:

means for updating the database;

means for wirelessly transmitting the updated data to a remote data storage system; and

means for storing the updated data at the remote data storage system.

2. A system according to claim 1 in which said means for transmitting comprises means for generating a Short Message Service message for transmission to the remote data backup service centre.

3. A data storage system comprising:

an updateable database;

means for updating data stored in the database;

means for producing a data message including a copy of the updated data; and

means for wirelessly transmitting said copied data to a remote data storage system for storage.

4. A system according to claim 3 in which said means for

transmitting comprises means for generating a Short Message Service message including said copied data for transmission to the remote data backup service centre.

5. A system according to any one of the preceding claims, in which the database is a storage means in a mobile station.

6. A system according to claim 5 in which the storage means is a memory in a Subscriber Identity Module (SIM) card for a mobile phone.

7. A system according to claim 5 or 6 in which the data is abbreviated dialling code data.

8. A system according to any one of claims 1 to 7 including means for receiving restore data wirelessly transmitted to the database from the remote data storage system, and writing said restore data in said database.

9. A system according to any one of claims 1 to 9 including means for automatically wirelessly transmitting said updated data on update of the data in the database.

10. A system according to claim 9 including:

a storage means including a flag in respect of each set of data for indicating which sets of data in the database have been updated since updated data was last transmitted; and

means for inserting updated data in a data message to be transmitted.

11. A system according to claim 10 including means for periodically calculating a checksum for each set of data stored in the database; and

means for comparing the calculated checksum with a stored checksum for the set of data;

wherein each said flag is indicative of whether the checksum and stored checksum are the same.

12. A system according to claim 11 when dependent on claim 5 in which the calculating of checksums for each set of data is performed sequentially in a series of time slots when the mobile station is in an "idle" mode.

13. A system according to any one of the preceding claims in which the data is transmitted in a series of data

messages.

14. A signal including:

data representative of data stored in a database; and

means for wirelessly directing the signal to a backup data service centre including a further database for storing the backup data.

15. A service centre comprising:

means for receiving data wirelessly transmitted from a remote database on update of the information stored in the database; and

means for storing the received data.

16. A service centre according to claim 15 including means for transmitting a message to the remote database to indicate that successful storage of the received data has taken place.

17. A service centre according to claim 15 or 16 wherein the received data is backup data.

18. A service centre according to claim 15 or 16 wherein

the remote database is included in a mobile station, said data relates to dialling numbers stored in the remote database, and the service centre includes a billing system using said data.

19. A method of backing up changes in a database comprising:

updating the database;

wirelessly transmitting the updated data to a remote data backup service centre; and

storing the updated data at the remote data storage service centre.

20. A method of updating a database comprising:

updating data stored in the database;

producing a data message including a copy of the updated data; and

wirelessly transmitting said data message data to a remote database for storage.

21. A method according to claim 19 or 20 in which said transmitting step comprises generating a Short Message Service message for transmission to the remote data backup

indicating which sets of data in the database have been updated since updated data was last transmitted; and

inserting updated data in a data message to be transmitted.

28. A method according to claim 27 including:

periodically calculating a checksum for each set of data stored in the database; and

comparing the calculated checksum with a stored checksum for the set of data;

wherein each said flag is indicative of whether the checksum and stored checksum are the same.

29. A method according to claim 27 or 28 including the step of periodically monitoring the data to determine whether the data has been updated since updated data was last transmitted.

30. A method according to claim 29 in which the database is on a mobile station and the monitoring operation is performed in a series of time slots on which the mobile station is in an "idle" mode.

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Application No: GB 0122598.6 **Examiner:** Hannah Sylvester
Claims searched: 1-32 **Date of search:** 22 October 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H4L (LDPPX, LECCP, LECCX, LEUX), G4A (AUDB)

Int Cl (Ed.7): H04Q 7/20, 7/24, 7/32, 7/34, 3/00, 3/545, 7/38, 3/42, 7/00, 7/36, 11/00, G06F 12/00, 12/30, 11/14, H04M 3/00, 11/00, 17/00, H04L12/22, 12/26

Other: Online: WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	US5970502A	(NORTEL) see whole document	At least: 1, 3, 14, 15, 19,20 and 32.
X	US5913160A	(AT&T) see whole document	At least: 1, 3, 14, 15, 19,20 and 32.
X	US5615364A	(SIEMENS) see whole document	At least: 1, 3,14,15,19 20 and 32
A	WO01/03409A1	(ERICSSON)	
A	WO98/41050A1	(NOKIA)	
A	WO98/12891A1	(NOKIA)	
A	WO97/01253A1	(MCI)	

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